

Science and Technology for National Security

Argonne Provides Full Support against Chemical and Biological Terrorism

Challenge

Terrorist attacks requiring small numbers of terrorists and relatively small amounts of toxic materials could have serious consequences in terms of casualties, economic dislocations, and population panic. This realization has changed the strategic focus for national defense. A new focus on detection, mitigation, and prevention of such acts is required.

Argonne's Role

Within the framework of its basic and applied science programs, Argonne National Laboratory maintains substantial expertise and facilities for addressing chemical and biological threats. These capabilities include instruments and sensors for detection of chemical and biological threats in the air, water, and soil — whether dispersed over kilometers or hidden within sites and caches. Facilities are also available for evaluating the effectiveness of chemical and biological monitoring methods at both the laboratory and field scales. Argonne can provide technical assistance in emergency situations and deploy fast-response systems for protecting first responders, estimating population exposures, decreasing exposure times, and reducing risk.

Resources

The Laboratory operates a unique Structural Biology Center that can provide information required to support the development of drugs, vaccines, and other pharmaceuticals for treatment of exposure. Other available resources include capabilities for determining the health and environmental risks from the dispersion of chemical and biological agents, along with the expertise needed for evaluating the potential effect of such agents on populations and materials (Figure 1). Argonne is also equipped to develop appropriate protective devices and materials (Figure 2) and methods of decontamination. Expertise, equipment, and facilities are available to conduct laboratory and field analyses for attribution of chemical/biological attacks.

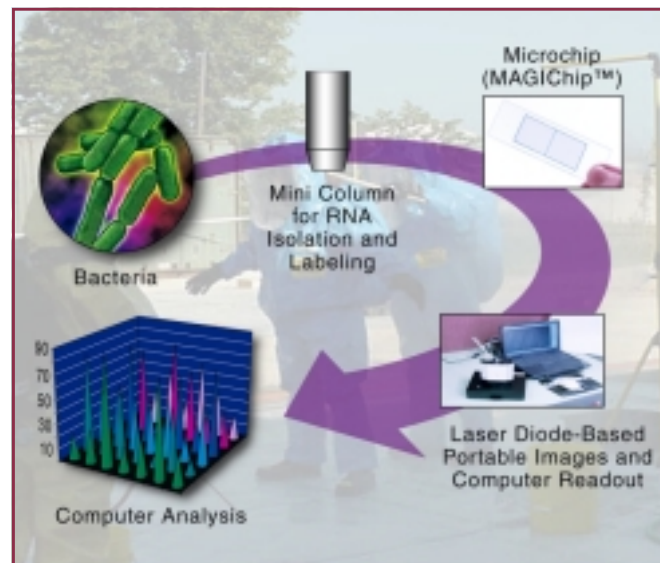


Figure 1. Argonne MAGIChip™-based portable detector for bacteriological identification features a mature microchip for anthrax detection.

Special-Purpose Laboratory Facilities

The Laboratory maintains a number of unique, special-purpose facilities that are available to support chemical and biological counter-terrorist activities. Most of the facilities described below were originally developed for, and continue to be used in support of, research and development programs conducted for sponsoring agencies other than those responsible for national security.

- *The Advanced Photon Source (APS)*, located at Argonne-East, is a high brilliance/high-energy synchrotron-based x-ray source that offers a variety of unique capabilities ranging from x-ray imaging of dense structures to dilute chemical substance identification to microcrystallography of biological species. The University of Chicago, Argonne's operator and a close collaborator in many scientific projects, owns/operates a biological safety level 3 (BSL-3) experimental end-station on one of the APS beamlines.
- *The Analytical Chemistry Laboratory (ACL)* provides many specialized analytical services, including detailed analysis of radioactive samples, elemental analysis of diluted mixtures, and a wide variety of organic analytical capabilities. The ACL performs analytical services for outside users on a regular basis but also has ample facilities and capabilities for nonroutine method development and testing.

- *The Electron Microscopy Center* possesses state-of-the-art, high-resolution scanning and transmission electron microscopes with diffraction-based phase identification and dispersive elemental identification capabilities. *In-situ* examinations, as a function of temperature and under ion bombardment conditions, are possible. These capabilities can be valuable for examination/characterization on nanoscale embodiments, such as those likely to be used in chem-bio detectors. The center is available to outside users.
- *The U.S. Army-Approved (Army Regulation 50-6 Level-2) Dilute Chemical Agent Facility* is certified to accept such agents as Soman, Sarin, and Lewisite. It is equipped for analytical method development, detector testing/verification, development of decontamination technologies, and transport model validation. The facility currently serves as an Emergency Response Laboratory to the U.S. Environmental Protection Agency (Region V) for events suspected of being terrorist attacks involving chemical agents.
- *The Mobile Laboratory for Chemical Agent Detection* characterizes the degree of chemical agent contamination in U.S. Army buildings. It can be equipped with a gas chromatograph/mass spectrometer (GC/MS), gas chromatograph/flame photometric detector (GC/FPD), or both. Samples can be taken and analyzed on-site for rapid turnaround time. The mobile unit can be used to confirm decontamination in cleanup operations. It operates on "shore" generator power.
- *The Intense Pulsed Neutron Source (IPNS)*, a user-oriented facility located at Argonne-East, has unique capabilities for the interrogation of substances (inorganic and organic) in the solid and liquid states by neutron diffractometry, reflectometry, and energy-resolved inelastic scattering. This facility is well suited to the study of molecular structures of chemical species and biological organisms, for which knowledge of proton positions and dynamics is a major issue.

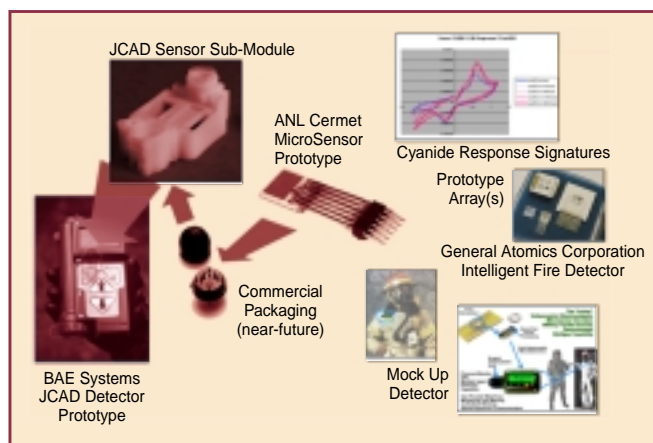


Figure 2. Argonne's cyanide gas microsensor may be used to protect military personnel and emergency first responders.

Achievements

Under the sponsorship of the U.S. Departments of Energy and Defense, the Laboratory has developed portable biochip microarrays capable of detecting and identifying anthrax and other bioagents. The Argonne bioagent detector is one of three that has been chosen for end-stage testing that will lead to large-scale application. For the Joint Chemical Aid Detector Program, the Laboratory developed a handheld cyanide-gas microsensor. With Sandia and Lawrence Livermore national laboratories, Argonne is demonstrating technologies for mitigating impacts from chemical and biological attacks on interior infrastructures deemed to be at high risk, such as subways, airports, and public buildings. The staff also participates in the U.S. Army program for assessing environmental risks associated with chemical agents.

Sponsors

U.S. Departments of Energy, Defense,
Transportation, and Agriculture
Defense Threat Reduction Agency
Federal Emergency Management Agency
U.S. Environmental Protection Agency
Defense Advanced Research Projects Agency

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